

### REMARKS

The various objections and rejections in the first office action are set out below, single spaced and in italics, with each being followed by the applicants' response thereto.

3. *Claims 1-7 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regards as the invention.*

*Claim 1 is as follows:*

*"A photoimagable polymer cured by a photocationic initiator, said polymer comprising a mixture of a polyfunctional epoxy resin and the condensation product of a bisphenol and an epihalohydrin, said polymer having a glass transition temperature of at least about 140° C and a fatigue life of at least about 10,000 cycles when measured at about a 3% strain."*

*The examiner is confused as to what is being claimed here for the following reasons:*

1. *A "polymer comprising a mixture of a polyfunctional epoxy resin and the condensation product of a bisphenol and an epihalohydrin" is not a single component. Where is the polymer? Are there two polymers?*

2. *What is photoimagable, the polymer before cure or after cure? The examiner notes that the physical properties set forth by applicants if directed to the tests run in the specification are to the cured already imaged no longer photoimagable materials because the materials are fully cured and tested after irradiation. If the photocationic initiator has been used to its full ability to cure the epoxy resins called a polymer then how can photoimaging occur after this point?*

3. *What is claimed? Is it the cured mixture of epoxies set forth as a "polymer" by applicants? Is it a polymer made from the mixture of epoxies, such as an adduct of the mixture which is further photocured? Is it the unimagable tested polymer set forth in the comparisons in the specification?*

*The examiner notes for the record that Epon Resin 1009F, i.e. the preferred "condensation product of a bisphenol and an epihalohydrin" set forth by applicants has a melting point of 130-140 thus would not alone have the required Tg of claim 1. See product bulletin Epon<sup>™</sup> Resin 1009R. Applicants' preferred polyfunctional epoxy resin is Tactix 742 which is cited by Dupont as tris-hydroxyphenylmethane glycidyl ether (CAS # 66072-38-6). RN 34590-59-5 cites Tactix 742 as a homopolymer of trihydroxytriphenylmethane triglycidyl ether while RN 66072-38-6, i.e. CAS# 66072-38-6, is the monomer of RN 34590-59-5. Applicants on page 7, reference Tactix 742 on page 9 as "a trihydroxy triphenylmethane trisglycidyl ether. Thus, applicants appear to*

*reference the monomer of RN 34590-59-5 when they reference Tactix and the definition set forth by Dupont. This does not appear to be a polymer at all.*

*Thus, what appears to be claimed by applicants is the cured product of an imageable composition comprised of (1) a photocationic initiator, (2) a polyfunctional epoxy resin and (3) a condensation product of a bisphenol and an epihalohydrin. To what the properties refer is unclear since the only photoimageable polymer around has to be part of the "mixture". However, these properties could refer to the cured product obtained from said composition. This is all there actual tests in the specification to support comparisons with other compositions.*

*Thus, with respect to these claims, the examiner has taken them to reference the cured composition with the properties set forth for examination purposes. This is the only interpretation that she can make sense of to examine in view of the specification as a whole. Finally, does "cured by a photocationic initiator" refer to a process step while "photoimageable polymer" refer to a compound or composition? Is the curing of the photoimageable polymer claimed or the photoimageable polymer claimed or the cured product of the photoimageable product claimed? This language is ambiguous as well as confusing.*

*Because of the confusion set forth above, claims 1-7 are held confusing.*

**RESPONSE:** Applicants respectfully submit that claim 1 as now amended overcomes the various rejections based on the second paragraph of 35 USC 112. This claim now clearly indicates that the fully cured and photoimaged polymer is being claimed. If the polymer were not cured, the claimed properties would be unattainable.

4. *Claims 8-14 and 20 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regards as the invention. Claim 8 is as follows:*

*"A photoimageable dielectric polymeric film having a flex fatigue resistance of at least about 10,000 cycles at about a 3% strain, and a glass transition temperature of at least about 140° C."*

5. *The specification sets forth completely curing an epoxy resin to form a " dielectric polymeric film having a flex fatigue resistance of at least about 10,000 cycles at about a 3% strain, and a glass transition temperature of at least about 140° C." This film is cured product of Tactix 742 and Epon 1009F and optionally Epon 1002F or Epon 1004F as set forth in Table 2 of applicants' own specification. These materials are no longer "photoimageable" in the sense that epoxy groups can still be cured through. The*

*properties obtained from this mixture of epoxy resins are the properties of the cured reaction product of these resins, not the mixture of these resins as set forth in claims 9-14. Applicants set forth no examples of the mixture having "a flex fatigue resistance of at least about 10,000 cycles at about a 3% strain, and a glass transition temperature of at least about 140° C". Thus, what is being claimed is unclear in view of the specification as a whole. This same problem occurs with claim 20 where the polymer has "a flex fatigue resistance of at least about 10,000 cycles at about a 3% strain, and a glass transition temperature of at least about 140° C" yet remains "photoimagable". Claim 20 is also confusing because reference is made to "the polymer" and "the reaction product" but the polymer is never identified as the reaction product. Thus, how the reaction product relates the polymer is unclear.*

**RESPONSE:** Applicants respectfully submit that claims 8 and 20 have now been amended to specifically overcome these difficulties noted by the examiner. The attention of the examiner is directed to examples 27-29, 46 and 55 in Table 2 on pages 16-18 of the specification, all of which show a Tg of at least about 140°C and a "cycles to fail" of at least 10,000. These provide the support that is needed to substantiate what is now being claimed. Within the framework of the present invention, sample failure occurs when the sample cracks and breaks into two pieces.

6. *Claims 21-27 and 32 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regards as the invention. Claim 21 is drawn to a "process of making a photoimagable dielectric" then sets forth a process wherein the end product is already photoimaged and fully cured thus no longer photoimagable in the sense that the cationic photoinitiator still exists to allow further photoimaging or that any epoxy groups are still around to allow any more imaging. Is the dielectric to be photoimaged after it is formed? There is no disclosure showing how this will occur. The examiner suggests the "process of making a dielectric" or "process of making a photoimaged dielectric". The process as set forth in claim 21 does not limit the final product to an imaged material. It is inclusive of films without image and overall cured without need for development. The same problem occurs with the process of making a photoimagable dielectric in claim 32.*

**RESPONSE:** With the amendment to claims 21 and 32, the basis for these §112 rejections is specifically overcome and the rejections are now rendered moot.

7. *The examiner has assumed for examination purposes all of the claims set forth are directed to the cured polymer or the process of forming the cured dielectric polymer. Thus, she has examined the process of curing and the final product which would have "a flex fatigue resistance of at least about 10,000 cycles at about a 3% strain, and a glass transition temperature of at least about 140° C" as set forth in the specification. She further notes that applicants have used a solvent in all of their comparisons, i.e. page 13, "Add solvent and place the mixture on a mechanical stirrer or roller mill apparatus" but have never identified it. The examiner notes that on page 15, Tactix 742 is identified as "trihydroxy triphenyl methane TGE" with no mention of glycidyl groups. TGE is not defined. On page 9 the same Tactix 742 has triglycidyl ether in it's name. TABLE 1 also refers to "BPA" which is not defined in the specification as is "GE" used and not defined anywhere in the specification.*

8. *Claim 20 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regards as the invention. What is meant by "epoxidied phenylformaldehyde novolac" is unclear in line 5 from the bottom. Is this supposed to be "epoxidized"? The same is found in claim 32, line 12. Thus, claims 20 and 32 are confusing.*

**RESPONSE:** The objectionable language has now been corrected in the claims, thereby removing the basis for these specific rejections of claims 20 and 32. Claims 19 and 25 have likewise been corrected. Furthermore, clarifying language has been inserted by amendment beneath Table 1 on page 15 of the specification.

10. *Claims 1-3, 8-10 and 15-16 are rejected under 35 U.S.C. 102(b) as being anticipated by Williamson et al (5,730,764). The EB Cured Resin of Table B wherein Tactix 742, i.e. the instant triglycidyl ether of tris (hydroxy phenyl), Der 383, i.e. a diglycidyl ether of Bisphenol A which is a product of bisphenol A and epichlorohydrin, and OPPI, i.e. 4-octyloxyphenyl)phenyl iodonium hexafluoroantimonate, i.e. a photocationic initiator. The cured resin yielded a material of Tg = 242 and a modulus of 1.41. This material inherently has a fatigue life of at least about 10,000 cycles when measured at about a 3% strain.*

**RESPONSE:** Applicants respectfully submit that the rejection of these claims as anticipated by Williamson should be withdrawn. The applicants have presented the test results conducted on 60 cured and photoimaged dielectric resins. Of this number, only a handful of samples (less than 10%) meet the criteria of the invention as claimed.

Accordingly, if the examiner continues this specific rejection, she is requested to provide specific information to back up her statement that **"This material inherently has a fatigue life of at least about 10,000 cycles when measured at about a 3% strain."** Otherwise, applicants believe this rejection to be unsupportable and without merit, and respectfully request that it be withdrawn. Furthermore, applicants specifically state on page 3, lines 6 and 7 of the specification that "Some epoxies have a high Tg, but the general trend is for materials with a high Tg to be brittle below the transition temperature." This language is counterintuitive to the examiner's contention of inherency. To show inherency, extrinsic evidence "must make clear that the missing descriptive manner is necessarily present in the thing described in the reference and that it would be so recognized by persons of ordinary skill". Continental Can Co. vs. Monsanto Co., 20 USPQ 2nd 1746,1749 (Fed. Cir. 1991). Continuing, "inherency, however, may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient" (page 1749).

As has been further stated by the courts, "A rejection for anticipation under section 102 requires that each and every limitation of the claimed invention be disclosed in a single prior art reference....In addition, the reference must be enabling and describe the applicants' claimed invention sufficiently to have placed it in possession of a person of ordinary skill in the field of the invention." See In re Paulsen, 30 F. 3<sup>rd</sup>, 1475, 1478 (Fed Cir. 1994). As stated in Advanced Display System, Inc. v. Kent State University, 54 USPQ2d 1673, 1679 (Fed Cir. 2000), "...invalidity by anticipation requires that the four corners of a single, prior art document describe every element of the claimed invention, either expressly or inherently, such that a person of ordinary skill in the art could practice

the invention without undue experimentation." A polymer or a polymeric film having the requisite fatigue life of 10,000 cycles is neither expressly described in Williamson nor is it inherent therein. Therefore, the rejection of these claims 1-3, 8-10 and 15-16 should be withdrawn.

11. *Claims 21, 23-26, 28, 30 are rejected under 35 U.S.C. 102(a or e) as being anticipated by Day et al (5,278,010). With respect to instant claims 21, 23-26, 28, 30, The processes of Day et al wherein the polyol resin is the condensation product of epichlorohydrin and bisphenol A, i.e. instant "condensation product of a bisphenol and an epihalohydrin", and epoxidized octafunctional bisphenol A formaldehyde novolak resin, i.e. polyfunctional epoxy resin anticipate the instant process. Table III shows mixtures of PKHC at 50 parts and SU-8 at 50 parts being used to form imaged layers with 5 parts UVE 1014 which is disclosed to be a sulfonium photoacid. This composition along with the intended use in forming solder masks as set forth in col. 5-6 of Day et al anticipate the instant processes. A third resin is also added as set forth in Table 1 of Day et al. It is EpiRez 5183 which is disclosed to have a weight per epoxide of 675 in col. 3, lines 30-33. If EpiRez 5183 is taken as the instant "condensation product of a bisphenol and an epihalohydrin" because it is made from a tetrabromo bisphenol A and epichlorohydrin to make the glycidyl ether groups then Table one has a resin mixture of EpiRez 5183 and SU-8 which is 50 parts to 30 parts by weight, respectively with 5 parts per 100 wt of resin then the imaging of this combination reads on the method as well. If PKHC and EpiRez 5183 combined as instant "condensation product of a bisphenol and an epihalohydrin" then the SU-8 is the instant polyfunctional epoxy resin then Example 1 in Table I of Day et al reads on the instant invention.*

**RESPONSE:** This rejection of claims 21, 23-26, 28 and 30 as anticipated by Day is no longer applicable in light of the amendment to claims 21 and 28, which specify that the process is capable of forming a dielectric (claim 21) or a polymeric film (claim 28) having a glass transition temperature of at least about 140° C.

12. *Claims 21, 23-26, 28, 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Day et al (5,278,010). With respect to instant claims 21, 23-26, 28, 30, the processes of making a solder mask as taught by Day et al make obvious the instant process wherein the composition of Day et al set forth in SUMMARY OF THE INVENTION reads on the instant composition with the exception of a broader range of polyol resin than the from 10-80 % wt than instant 30-70 parts of the instant "condensation product of a bisphenol and an epihalohydrin", and between about 20%*

and about 90% by weight of an epoxidized octafunctional bisphenol A formaldehyde novolak resin instead of the 30-70 parts of instant polyfunctional epoxy resin. The Day et al composition also has about 0.1 to about 15 parts by weight per 100 parts of resin of a cationic photoinitiator capable of initiating polymerization of said epoxidized resin system upon exposure to actinic radiation which reads on the instant cationic photoinitiator. The optional between about 35% and 50% by weight of an epoxidized glycidyl ether of tetrabromo bisphenol A having a softening point of between about 60.degree. C. and about 110.degree. C. and a molecular weight of between about 600 and 2,500 of Day et al also overlaps the instant optional third epoxy resin. While the ranges are not the exact same as the instant ranges, they overlap substantially and as such in the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. *In re Wertheim*, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990). The process of forming a solder mask set forth by Day et al includes a printed circuit board comprising a printed circuit substrate, and a photo sensitive cationically polymerizable epoxy based imaging system disposed on said substrate and imaged, developed and cured to form a solder mask and further defined as the photoimageable material is typically curtain coated by conventional curtain coating techniques onto a substrate to a thickness of about 0.5 to about 4.0 mils or more, dried, photoimaged and developed. The developed areas reveal the desired underlying metallized portions of the substrate wherein solder is to be applied, and the remaining solder mask material is cured and remains on the board as a solder mask during the application of solder by any conventional technique.

The more specific choices taught by Day et al are:

"In general, the epoxy resin system consists essentially of a phenoxy polyol resin of a high molecular weight which is a condensation product between epichlorohydrin and bisphenol A. A suitable resin of this type is sold by Union Carbide Corporation under the Trade Mark PKHC. This resin has an epoxide value of about 0.03 equivalents per kg, a weight per epoxide of about 37,000, and a Tg (glass transition temperature) of about 98° C. The second resin in the system is an epoxidized octafunctional bisphenol A formaldehyde novolak resin with a medium range molecular weight. A suitable resin of this type is sold by High Tek Polymers under the Trade Mark EpiRez SU-8. This resin has an epoxide value of about 4.7 equivalents per kg, a weight per epoxide of about 215 and a melting point of about 82 ° C. These two resins will provide the necessary rheological, photolithographic and physical properties necessary to curtain coat for solder mask applications. However, in many instances, flame retardancy is desirable, and these two resins do not exhibit adequate flame retardancy for many applications. In such cases a third resin is added for flame retardancy. The third resin in the system is a low molecular weight high softening point epoxidized glycidyl ether of tetrabromo bisphenol A. A suitable resin of this type is also sold by High Tek Polymers Corporation under the Trade Mark EpiRez 5183. This resin has an epoxide value of about 1.5 equivalents per kg, a weight per epoxide of about 675, and a melting point of about 97°C. A photoinitiator such as various sulfonium salts, iodonium salts, and ferrocene salts is added to the resin system for providing the proper photoresponse to actinic radiation. Since the resin system is cationically photocurable, the photoinitiator must be capable of causing

*cationic polymerization of the resin upon exposure to radiation. One particularly desirable photoinitiator is a complex triarylsulfonium hexafluoroantimonate salt sold by General Electric Company under the Trade Mark UVE 1014. Other photoinitiators such triphenylsulfonium hexafluorophosphate sold by General Electric Co. under the Trade Mark UVE 1016, and diphenyliodonium hexafluoroantimate may be used. Optionally a photosensitizer such as anthracene or its derivatives or perylene or its derivatives can also be added which may increase the response speed of photoimaging and/or the wavelength sensitivity. The different epoxy resins described above, selected to be within certain molecular weight ranges, are blended in certain percentages."*

*Thus, with respect to instant claims 21, 23-26, 28, 30, the processes of Day et al make obvious the instant processes wherein the choice of photocationic initiator is fully taught and the ranges are fully encompassed by those of Day et al for the reasons set forth above. In Day et al, see particularly col. 2, lines 25-40, col. 3, col. 5, lines 20-col. 6, lines 55 and claims.*

**RESPONSE:** The rejection of these same claims as obvious in light of the teachings of Day et al is no longer relevant and should be withdrawn. The court held in In re Pantzer et al, (CCPA 1965) 341 F.2d 121, 144 USPQ 415, that an invention is obvious if one of ordinary skill in the art would consider it logical to anticipate with a high degree of probability that a trial of it would be successful. There is nothing in the cited references or in anything cited by the examiner which would indicate that a person skilled in the art could anticipate the results obtained with a high degree of probability. The court in In re Fisher (CCPA 1970) 427 F.2d 833, 166 USPQ 18, held that there is a lower degree of predictability in chemical reactions and physiological activity than in mechanical and electrical environments. The law is quite clear that in order for a claimed invention to be rejected on obviousness, the prior art must suggest the modifications sought to be patented; In re Gordon, 221 U.S.P.Q. 1125, 1127 (CAFC 1984); ACS Hospital System, Inc. v. Montefiore Hospital, 221 U.S.P.Q. 929, 933 (CAFC 1984). The foregoing principle of law has been followed in Aqua-Aerobic Systems, Inc. v. Richards of Rockford, Inc., 1 U.S.P.Q. 2d, 1945 (D.C. Illinois 1986). In the Aqua-Aerobic's case, the Court stated that the fact that a prior

reference can be modified to show the claimed invention does not make the modification obvious unless a prior reference suggests the desirability of the modification.

In In Re Oetiker, 24 U.S.P.Q. 2nd 1443, 1445 (CAFC 1992) held:

"There must be some reason, suggestion, or motivation found in the prior art whereby a person of ordinary skill in the field of the invention would make the combination. That knowledge can not come from the applicants' invention itself."

Most significantly, the CAFC in the case of In Re Dembiczak, 50 U.S.P.Q.

2<sup>nd</sup> 1614 (CAFC 1999), held at 1617:

"...(examiner can satisfy burden of obviousness in light of combination 'only by showing some objective teaching [leading to the combination]');"

Thus, it is clear that where an individual reference does not teach the entire invention, then the modification which the invention represents must be suggested and motivated by some other reference or through some objective teaching and cannot come from the application itself. Here, there is but one reference cited. Hence, there clearly is no suggestion of modifications in any way, let alone as suggested by the Examiner.

13. *Claims 24-25 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regards as the invention. Claim 24 recites the limitation "improving the flex fatigue life of the polymer without lowering the glass transition temperature below about 140° C" in lines 2-4. There is insufficient antecedent basis for this limitation in the claim because there is no antecedent basis for "the polymer" to which all these properties belong.*

**RESPONSE:** Claim 24 has now been canceled and the subject matter has been incorporated into claim 21 to overcome this obstacle. Accordingly, the dependency of claim 25 has been changed. This rejection can now be withdrawn.

14. Claims 21, 23-28, 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Foster et al (6,528,218 B1). With respect to instant claims 21, 23-28, 30, the processes of Foster et al teach all of the instant process with the exception of the specific ranges of composition components present. In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. *In re Wertheim*, 541 F.2d 257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990). This is the case with the compositions of Foster et al generally taught of use in their processes. The process set forth by Foster et al is as found in col. 6, lines 18-64

"A polymeric cover sheet, also known as an interleaving, if present, is peeled from the photoimageable dielectric film, and the photoimageable dielectric film is placed film-side down onto the substrate. If the polymeric support is optically transparent, the polymeric support sheet remains atop the photoimageable dielectric film. (If the polymeric support is not optically transparent, then such polymeric support is removed and an optically transparent sheet is placed atop the photoimageable dielectric film.) Suitable substrates include for example, non-circuitized power cores, stiffeners, circuitized substrates such as circuit boards, cards, carriers, organic and inorganic single chip modules, organic or inorganic multi-chip modules, ceramic carriers and interposer cards. The photoimageable dielectric film is applied to the substrate, preferably by vacuum lamination. The photoimageable dielectric film is then photopatterned using conventional techniques, by exposing to actinic radiation, preferably ultraviolet light. The photoimageable dielectric film has the advantage of not needing to be dried prior to exposure to the actinic radiation. Preferably, the photoimageable dielectric film is exposed to ultraviolet light through desired artwork to expose areas corresponding to the position of the desired location of the apertures. The optically transparent sheet, which is preferably the support sheet, is removed from the photoimageable dielectric film, and photoimageable dielectric film is then baked to partially cure the photoimageable dielectric film in the areas exposed to actinic radiation.

The photoimageable dielectric film is then developed, preferably using propylene carbonate or butyrolactone to provide a photoimaged dielectric film having photoimaged apertures, such as photoimaged vias disposed therein. The photoimaged dielectric film is then finally cured, preferably in a two step process, first involving an exposure to ultraviolet light in the range of 250 to 400 nm, at from about 1 to about 8 J/cm<sup>2</sup>, followed by a thermal cure. Good thermal cures have been obtained in a convection oven at 150° C. to 180° C. for 30 to 90 minutes."

The most pertinent composition used in the processes of Foster et al to the instant process is set forth in col. 3, lines 16-41 as follows:

In the first embodiment, the solids comprise an epoxy resin system which is preferably comprised of: from about 5% to about 80%, preferably from 10 to about 40%, more preferably from about 15% to about 30% of the phenoxy polyol resin which is the condensation product of epichlorohydrin and bisphenol A, having a molecular weight of from about 40,000 to about 130,000, preferably about 60,000 to about 90,000, more

*preferably greater than 60,000; from preferably from about 10% to about 90%, more preferably from about 12% to about 30%, most preferably from about 15% to about 20%, of an epoxidized multifunctional bisphenol A formaldehyde novolac resin having a molecular weight of from about 4,000 to about 10,000, preferably about 5,000 to about 7,000; from about 20% to about 50%, preferably from about 25% to about 40%, more preferably about 27% to about 35% of a diglycidyl ether of bisphenol A having a molecular weight of from about 600 to about 2,500, preferably about 1,000 to about 1,700; from about 10% to about 35%, preferably from about 13% to about 32%, more preferably from about 20% to about 30%, liquid epoxy resin and from about 0.1 to about 15 parts, preferably about 5 parts, by weight of the total resin weight, a cationic photoinitiator. The solids optionally comprise a particulate rheology modifier from 0 to about 30%, preferably from 0.25% to about 30%, preferably from about 0.3% to about 5%, most preferably from about 0.5% to about 4%.*

*The phenoxy polyol resin which is the condensation product of epichlorohydrin and bisphenol A; is the instant condensation product of a bisphenol and an epihalohydrin, and the epoxidized multifunctional epoxide as the instant component polyfunctional epoxy resin.*

**RESPONSE:** The rejection of these claims 21-23, 28 and 30 as being obvious in light of the teachings of Foster et al should be withdrawn for the reasons noted by applicants following the next claim rejection as anticipated by Foster et al.

15. *Claims 1, 6-9, 11, 13-15, 17, 21, and 24-27 are rejected under 35 U.S.C. 102(e) as being anticipated by Foster et al (6,528,218 B1). With respect to instant claims 21 and 24-27, Example 7 and 6 of Foster et al anticipate the instant process wherein (1) the Tg is 140 °C, (2) ERL is ERL 4221, i.e. 3,4 - epoxycyclohexylmethyl - 3,4 - epoxy-cyclohexane-carboxylate with an epoxy equivalent weight of from about 131 to about 143, (3) 826 is Epon 826, i.e. a diglycidyl bisphenol A epoxy resin having an epoxide equivalent weight of from about 178 to about 186, (4) with the epoxide components of Batch S and Batch 6 being PKH, a phenoxy resin which is the condensation product of epichlorohydrin and bisphenol A, Epi-res 5183 which is a diglycidyl ether of bisphenol A, and Eptrez SU-8 being an octafunctional epoxy bisphenol A formaldehyde novolac resin and the photoinitiator being UVI 674, i.e. a sulfonium photoacid generator. With respect to instant claims 1, 6-9, 11, 13-15, 17, the cured polymers on a substrate in the imaged and finally cured materials of Example 7 of Foster et al are held to inherently have a fatigue life of at least about 10,000 cycles when measured at about a 3% strain and are recorded by Foster et al to have a Tg of 140 ° C.*

**RESPONSE:** The anticipation rejection of these claims based on Foster et al should be withdrawn for the same reasons as articulated in connection with the Williamson et al reference discussed above. Foster et al do not include, either expressly or impliedly, all of the features as claimed by applicants in the rejected claims. Furthermore, to suggest that the cured materials of Example 7 would have the fatigue life claimed by applicants is totally without foundation. It should be noted that Foster et al provide a low molecular weight epoxy to provide low flexibility to the film before curing. Such an epoxy tends to be somewhat brittle. The purpose of Foster et al is to allow the uncured resin composition to be handled in a dry form. In the present invention, the resin is formulated so that the film after curing has high flex fatigue life while at the same time maintaining a high Tg above about 140° C.

As noted in lines 18 and 19 of page 19 of the instant specification, "Formulations with a higher Tg tended to be brittle." Again, this observation is contrary to the view of the examiner that the cured films of Foster et al inherently have a fatigue life of about 10,000 cycles when measured at about a 3% strain.

16. *Claim 8 is rejected under 35 U.S.C. 102(b) as being anticipated by Janke et al (5,726,216). The last Prepeg Resin system in Table 5 of Janke et al has a TG of 144° C and inherently has a fatigue life of at least about 10,000 cycles when measured at about a 3% strain. Tactix 742 is the same trifunctional epoxy resin used by applicants and Ekp 207 is an epoxidized rubber and OPPI is a photocationic agent. The cured material is as inherently photoimable as the cured layers of applicants. In Janke et al, see particularly Abstract, col. 4, lines 42-47, paragraph at end of col. 5, col. 6, col. 9-10.*

**RESPONSE:** The rejection of claim 8 is based on the fallacy that the properties of Janke et al are somehow inherently superior to over 90% of the specimens that were

tested and that were listed in applicants' specification as having failed the flex test. This supposition is not supportable and the rejection should be withdrawn.

17. Claims 1-20, 24-25, 31-32 and 32 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. All of instant claims 1-20 and 32 have a limit of a polymer or polymeric film or photoimagable dielectric which has "a fatigue life of at least about 10,000 cycles when measured at about a 3% strain." Claims 24-25 and claims 31-32 reference the addition of a third epoxy "capable of improving the flex fatigue life of the polymer". Applicants disclose only one test for "flex fatigue life" in their specification. There is more than one recognized manner of testing "flex fatigue life" known in the art. The examiner cites Fjelstad to show just four of which as far as the examiner can determine applicants are using "The Fatigue Ductility Flex Tester". "Fatigue Life" is "Number of cycles of fluctuating stress and strain of a specified nature that a material will sustain before failure occurs. Fatigue life is a function of the magnitude of the fluctuating stress, geometry of the of the specimen and test conditions" as set forth by Instron. According to Fisk Alloy Conductors, Inc. "Flex life - (or flex fatigue life) is the number of cycles a sample can withstand when subjected to a repetitive stress or strain before failure." They go on to disclose "Flex life results are not "exact" as the range of results within a test group, between test groups and between test apparatus often produces a large standard deviation. Hence there are no standard values to use for comparison." The examiner does note that Fisk seems to be interested in metals. Thus, for the test to be of value in testing materials side by side, it must be fully set forth. Applicants do not refer to a standard for how their test will be run, but disclose the test on page 14. They do not set forth what "sample failure" means. On page 18, they note that some cycles are counted until failure at one mandrel size, i.e. note 3, but some cycles are counted as "cycles to fail at 3.0 % strain from cycles to fail vs. % strain curve. There is no disclosure as to how this strain number is obtained or how the strain curve is obtained. There is no disclosure as to what weight is used in the "flex fatigue tester" of page 14 or which "flex fatigue tester" is used. The examiner notes that "such as Model 2FDF Fatigue Ductility Flex Tester available from Jovil/Universal Manufacturing Company in Danbury, Connecticut" does not say that that was the flex fatigue tester to be used or was used. Mil-P-50884C on page 42 wherein the Model 2FDF Fatigue Ductility Flex Tester is used for testing printed wiring references on page 12 at 3.6.6.1 looks to electrical discontinuity, short circuits, degradation or rejectable delamination as failure, but applicants have no circuit to test or check for failure. EPC-TM-650 using the same machine as cited by applicants also address at 5.2.3 electrical discontinuity as failure and at 5.3.3 reference how to extrapolation to other bend radii or fatigue lives, i.e. at different diameter mandrels. On page 42, of Mil-P-50884C, there is requirement that not only number of flex cycles, diameter of mandrel, and travel of loop be specified but that flexing rate and points of application also be specified. A conductivity failure is set forth by Dueber et al (5,536,620) in their Flex/Bend Test in col. 13 using the same machine.

*Bryant et al (4,684,420) while testing with an NITS flex tester considered crack to be failure with their paints. Applicants have not set forth the solvent used to make the layers tested, nor have they set forth the thickness of layers tested, nor have they set forth how to standardize to 3% strain for comparison. In view of all of applicants' failure to set forth enough test criteria to allow a worker of skilled in the art to repeat the standard applicants have failed to enable said worker to know where the limits of their invention lay. The tests run are on two different standards neither of which is clear as to how it is run and they have failed to explain how the two standards compare with respect to the cycle numbers given. Thus, because applicants have given insufficient information with respect to their flex fatigue life test, claims 1-20, 24-25 and 31-32 are non enabled.*

**RESPONSE:** The rejection of these claims is now rendered irrelevant by the amendatory language that was inserted into the claims. Furthermore, the test procedure noted on page 14 of the specification is sufficiently detailed to permit one skilled in the art to duplicate the tests. These procedures are spelled out as follows:

"A large number of different polymers were formulated and measured for Tg and flex fatigue. Each of the polymers contains at least one polyfunctional epoxy compound blended with a second epoxy compound and/or a thermoplastic component. Some of the blends contain a filler, such as silica or a polyimide powder. Many formulations are evaluated for Tg, CTE, and flex fatigue life at room temperature. These are based on commercially available epoxy resins advertised as having a high impact resistance, or as being flexible. These materials are blended with other resins and a cationic photoinitiator according to the following procedure:

- Combine measured amounts of the resin components into small plastic vessel.
- Add solvent and place the mixture on a mechanical stirrer or roller mill apparatus.
- Once the resins are dissolved (12-24 hr), the catalyst is added and the mixture is stirred for an additional hour.
- Thin films (40-60  $\mu\text{m}$ ) are prepared on aluminum foil via drawdown technique using a wire wound rod (doctor blading).
- The films are air dried for 30 min, and then oven dried at 125° C for 10 min.
- The samples are then exposed to UV irradiation (Fusion tool) to initiate crosslinking.

- The samples then undergo a post-expose bake at 165° C for 60 min.

The samples are tested by thermal mechanical analysis (TMA) for Tg, CTE, and flex fatigue life according to the following procedure:

- Several 1/8" width strips are cut from the above samples.
- The aluminum foil backing is peeled away, and ~ 1" length samples are cut.
- The ends of the samples are taped to 10" x 1/2" paper strips and loaded on a flex fatigue tester, such as a Model 3FDF Fatigue Ductility Flex Tester available from Jovil/Universal Manufacturing Company in Danbury, Connecticut. Each sample is formed into a loop and is positioned around a mandrel having a specific diameter. For these tests, three mandrels having diameters of 24, 48 and 72 microns are used. A small weight is attached to the paper loop to provide sufficient tension to provide a 3% strain on the sample.
- A rotating motor cam provides an oscillating movement to the sample, and the number of oscillations are counted until failure.

Each sample is heated and the thermal expansion of the material is measured during heating. The coefficient of thermal expansion (CTE) of most polymeric materials increases significantly when the material is heated above the glass transition temperature). The resultant curve is then extrapolated to determine both the Tg and the CTE."

Applicants respectfully submit that the reference to a solvent in this procedure is sufficient to permit the skilled practitioner to replicate the procedure for preparing the blends. Furthermore, although the examiner went into considerable detail to explain various fatigue life test procedures, this information is irrelevant to the issue concerning the ability to duplicate the tests. Applicants submit that these tests are specific enough for the intended purpose of teaching one how to perform the tests. Accordingly, this rejection should be withdrawn.

*18. Claims 15-16, 18-22, 24-32 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicants regards as the invention. With respect to instant claims 15-16, 18-22, 24-32, applicants require an "an effective amount of cationic photoinitiator" but*

*do not make clear effective for what. Thus, claims 15-16, 18-22, 24-32 are held vague with respect to this limit.*

**RESPONSE:** The rejection of these claims is no longer relevant inasmuch as the claims have been amended to indicate that the cationic photoinitiator is a curing agent.

19. *The prior art made of record and not relied upon is considered pertinent to applicants' disclosure. Small, Jr. (4,554,229) teaches the need for photodefined dielectric layers having a Tg of at least 140 °C being required in the art of integrated circuits as early as 1985.*

**RESPONSE:** The Small patent, as well as the cited patents that were not specified in the rejection, have been reviewed by the applicants and are considered to be no more relevant than the ones cited and applied by the examiner in her rejection. Accordingly, they will not be addressed in detail in this response.

### CONCLUSION

Applicants respectfully submit that the claims as now amended clarify all of the language that the examiner believed to be ambiguous or inaccurate. Furthermore, the various rejections based on anticipation and obviousness have been met and overcome.

Accordingly, applicants respectfully request that the examiner allow the claims as now worded.

Respectfully submitted,

Date:

*Dec. 11, 2003*

By

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